

## CLAIMS

1. Crosslinkable elastomeric composition comprising:
  - at least one vulcanized rubber in a subdivided form surface treated with at least one silane coupling agent;
  - 5 - at least one diene elastomeric polymer;
  - at least one sulfur-based vulcanizing agent.
2. Crosslinkable elastomeric composition according to claim 1, wherein, the vulcanized rubber in a subdivided form has a particle size not higher than 5 mm.
3. Crosslinkable elastomeric composition according to claim 1, wherein the 10 vulcanized rubber in a subdivided form has a particle size not higher than 1 mm.
4. Crosslinkable elastomeric composition according to claim 3, wherein the vulcanized rubber in a subdivided form has a particle size not higher than 0.5 mm.
5. Crosslinkable elastomeric composition according to any one of the preceding 15 claims, wherein the vulcanized rubber in a subdivided form is present in an amount of from 2 phr to 90 phr.
6. Crosslinkable elastomeric composition according to claim 5, wherein the vulcanized rubber in a subdivided form is present in an amount of from 5 phr to 30 phr.
7. Crosslinkable elastomeric composition according to any one of the preceding 20 claims, wherein the vulcanized rubber in a subdivided form comprises at least one crosslinked diene elastomeric polymer or copolymer selected from: cis-1,4-polyisoprene, 3,4-polyisoprene, polybutadiene, optionally halogenated isoprene/isobutene copolymers, 1,3-butadiene/acrylonitrile copolymers, styrene/1,3-butadiene copolymers, styrene/isoprene/1,3-butadiene copolymers, styrene/1,3-butadiene/acrylonitrile copolymers, or mixtures thereof.
- 25 8. Crosslinkable elastomeric composition according to any one of the preceding claims, wherein the vulcanized rubber in a subdivided form comprises at least one crosslinked elastomeric polymer of one or more monoolefins with an olefinic comonomer or derivatives thereof,

- 30 -

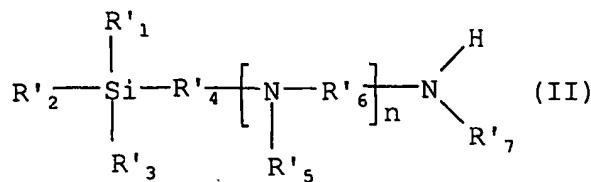
9. Crosslinkable elastomeric composition according to claim 8, wherein the crosslinked elastomeric polymer is selected from: ethylene/propylene copolymers (EPR) or ethylene/propylene/diene copolymers (EPDM); polyisobutene; butyl rubbers; halobutyl rubbers, in particular chlorobutyl or bromobutyl rubbers; or mixtures thereof.
- 5 10. Crosslinkable elastomeric composition according to any one of the preceding claims, wherein the diene elastomeric polymer is selected from: cis-1,4-polyisoprene, 3,4-polyisoprene, polybutadiene, optionally halogenated isoprene/isobutene copolymers, 1,3-butadiene/acrylonitrile copolymers, styrene/1,3-butadiene copolymers, styrene/isoprene/1,3-butadiene copolymers, styrene/1,3-butadiene/acrylonitrile 10 copolymers, or mixtures thereof.
11. Crosslinkable composition according to any one of the preceding claims, wherein the elastomeric composition comprises at least one elastomeric polymer of one or more monoolefins with an olefinic comonomer or derivatives thereof.
12. Crosslinkable elastomeric composition according to claim 11, wherein the 15 elastomeric polymer is selected from: ethylene/propylene copolymers (EPR) or ethylene/propylene/diene copolymers (EPDM); polyisobutene; butyl rubbers; halobutyl rubbers; or mixtures thereof.
13. Crosslinkable elastomeric composition according to any one of the preceding claims, wherein the silane coupling agent is selected from sulfide silane compounds 20 having the following formula (I):



wherein Z is selected from the following groups:  $-\text{Si}(\text{R}_1)_2(\text{R}_2)$ ,  $-\text{Si}(\text{R}_1)(\text{R}_2)_2$  and  $-\text{Si}(\text{R}_2)_3$ , in which  $\text{R}_1$  is a  $\text{C}_1\text{-C}_4$  alkyl group, a cyclohexyl group or a phenyl group and  $\text{R}_2$  is a  $\text{C}_1\text{-C}_{18}$  alkoxy group or a  $\text{C}_5\text{-C}_8$  cycloalkoxy group; Alk is a divalent hydrocarbon 25 containing from 1 to 18 carbon atoms and n is a number from 2 to 8.

14. Crosslinkable elastomeric composition according to any one of claims 1 to 12, wherein the silane coupling agent is selected from aminosilane compounds having the following formula (II):

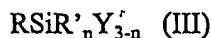
- 31 -



wherein:

- $\text{R}'_1$ ,  $\text{R}'_2$  and  $\text{R}'_3$ , which may be identical or different, are selected from hydrogen,  $\text{C}_1\text{-C}_8$  alkoxy groups,  $\text{C}_1\text{-C}_{18}$  alkyl groups,  $\text{C}_6\text{-C}_{20}$  aryl groups,  $\text{C}_7\text{-C}_{30}$  alkylaryl or arylalkyl groups, on condition that at least one of the groups  $\text{R}'_1$ ,  $\text{R}'_2$  and  $\text{R}'_3$  represents an alkoxy group;
- $\text{R}'_4$  is selected from  $\text{C}_1\text{-C}_8$  alkylene groups,  $\text{C}_6\text{-C}_{20}$  arylene groups, said arylene groups optionally being substituted with  $\text{C}_1\text{-C}_8$  alkyl groups;
- $\text{R}'_5$  and  $\text{R}'_7$ , which may be identical or different, are selected from hydrogen,  $\text{C}_1\text{-C}_{18}$  alkyl groups; or, when  $\text{R}'_5$  and  $\text{R}'_7$  are other than hydrogen, they may form, together with the nitrogen atoms to which they are attached, 5- or 6-membered heterocyclic rings;
- $\text{R}'_6$  is selected from  $\text{C}_1\text{-C}_{18}$  alkylene groups,  $\text{C}_6\text{-C}_{14}$  arylene groups, arylene groups optionally substituted with  $\text{C}_1\text{-C}_{18}$  alkyl groups,  $\text{C}_7\text{-C}_{30}$  alkylenearylene or arylenealkylene groups,  $\text{C}_3\text{-C}_{30}$  cycloalkylene groups, said cycloalkylene groups optionally being substituted with  $\text{C}_1\text{-C}_{18}$  alkyl groups;
- $n$  is an integer from 0 to 5 inclusive.

15. Crosslinkable elastomeric composition according to any one of claims 1 to 12, 20 wherein the silane coupling agent is selected from vinylsilane compounds having the following formula (III):

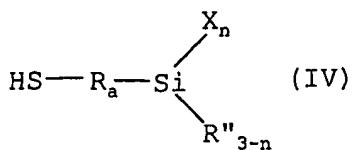


wherein:

- $\text{R}$  represents an alkenyl group or an alkenyloxy group;
- $\text{R}'$  represents an hydrogen atom or an alkyl group;

- Y represents a hydrolyzable organic group; and
- n is 0, 1 or 2.

16. Crosslinkable elastomeric composition according to any one of claims 1 to 12, wherein the silane coupling agent is selected from mercaptosilane compounds having 5 the following formula (IV):



wherein:

- X represents an halogen atom selected from chlorine, bromine, iodine, fluorine, a C<sub>1</sub>-C<sub>8</sub> alkoxy group;
- 10 - R<sub>a</sub> represents a C<sub>1</sub>-C<sub>10</sub> alkylene group;
- R'' represents a C<sub>1</sub>-C<sub>30</sub> alkyl group, a C<sub>7</sub>-C<sub>30</sub> alkylaryl or arylalkyl group, a C<sub>5</sub>-C<sub>30</sub> cycloaliphatic group, a C<sub>6</sub>-C<sub>20</sub> aromatic group;
- n is an integer from 1 to 3 inclusive

17. Crosslinkable elastomeric composition according to any one of claims 1 to 12, 15 wherein the silane coupling agent is selected from epoxysilane compounds such as 3-glycidyloxypropyltrimethoxy-silane, 3-glycidyloxypropylmethyldimethoxysilane, 2-(3,4 epoxycyclohexyl)ethyltrimethoxysilane, or mixture thereof.

18. Crosslinkable elastomeric composition according to any one of the preceding 20 claims, wherein the vulcanized rubber in a subdivided form is surface treated with an amount of at least one silane coupling agent of from 0.1% by weight to 5% by weight, said amount being expressed with respect to the total weight of the vulcanized rubber in a subdivided form + the silane coupling agent.

19. Crosslinkable elastomeric composition according to claim 18, wherein the 25 vulcanized rubber in a subdivided form is surface treated with an amount of at least one silane coupling agent of from 0.2% by weight to 3% by weight, said amount being expressed with respect to the total weight of the vulcanized rubber in a subdivided form

+ the silane coupling agent.

20. Crosslinkable composition according to any one of the preceding claims, wherein the sulfur-based vulcanizing agent is selected from:

- soluble sulfur (crystalline sulfur);
- 5 - insoluble sulfur (polymeric sulfur);
- sulfur dispersed in oil;
- sulfur donors such as, tetramethylthiuram disulfide (TMTD), tetrabenzylthiuram disulfide (TBzTD), tetraethylthiuram disulfide (TETD); tetrabutylthiuram disulfide (TBTD), dimethyldiphenylthiuram disulfide (MPTD), pentamethylenethiuram 10 tetrasulfide or hexasulfide (DPTT), morpholinobenzothiazole disulfide (MBSS), N-oxydiethylenedithiocarbamyl-N'-oxydiethylene-sulphenamide (OTOS), dithiodimorpholine (DTM or DTDM), caprolactam disulfide (CLD).

21. Crosslinkable composition according to claim 20, wherein said sulfur-based vulcanizing agent is present in an amount of from 0.5 phr to 5 phr.

15 22. Crosslinkable elastomeric composition according to any one of the preceding claims, wherein at least one reinforcing filler is present, in an amount of from 0.1 phr to 120 phr.

23. Crosslinkable elastomeric composition according to claim 22, wherein the reinforcing filler is carbon black.

20 24. Crosslinkable elastomeric composition according to claim 22, wherein the reinforcing filler is silica.

25. Crosslinkable elastomeric composition according to claim 24, wherein a silica coupling agent is present.

26. Crosslinkable composition according to claim 24, wherein the vulcanized rubber in subdivided form is surface pre-treated with at least one silane coupling agent.

27. Tire for vehicle wheels, comprising at least one structural element obtained by crosslinking a crosslinkable elastomeric composition comprising:

- at least one vulcanized rubber in a subdivided form surface treated with at least

one silane coupling agent;

- at least one diene elastomeric polymer;
- at least one sulfur-based vulcanizing agent.

28. Tire for vehicle wheels according to claim 27, comprising:

5 - a carcass structure shaped in a substantially toroidal configuration, the opposite lateral edges of which are associated with respective right-hand and left-hand bead wires to form respective beads;

- a belt structure applied in a radially external position with respect to said carcass structure;

10 - a tread band radially superimposed on said belt structure;

- a pair of sidewalls applied laterally on opposite sides with respect to said carcass structure;

wherein said structural element obtained by crosslinking a crosslinkable elastomeric composition comprising:

15 - at least one vulcanized rubber in a subdivided form surface treated with at least one silane coupling agent;

- at least one diene elastomeric polymer;

- at least one sulfur-based vulcanizing agent;

is the tread band.

20 29. Tire for vehicle wheels according to claim 27 or 28, wherein the vulcanized rubber in a subdivided form is defined according to any one of claims 2 to 9.

30. Tire for vehicle wheels according to any one of claims 27 to 29, wherein the diene elastomeric polymer is defined according to any one of claims 10 to 12.

31. Tire for vehicle wheels according to any one of claims 27 to 30, wherein the silane coupling agent is defined according to any one of claims 13 to 19.

32. Tire for vehicle wheels according to any one of claims 27 to 31, wherein the

sulfur-based vulcanizing agent is defined according to claim 20 or 21.

33. Tire according to any one of claims 27 to 32, wherein at least one reinforcing filler is present in the crosslinkable elastomeric composition as defined according to any one of claims 22 to 26.

5 34. Crosslinked manufactured product obtained by crosslinking a crosslinkable elastomeric composition as defined according to any one of claims 1 to 26.

35. Process for producing a crosslinkable elastomeric composition comprising the following steps:

10 (a) surface treating at least one vulcanized rubber in a subdivided form with at least one silane coupling agent;

(b) mixing the surface treated vulcanized rubber in a subdivided form obtained in step (a) with at least one diene elastomeric polymer;

(c) adding to the elastomeric composition obtained in step (b) at least one sulfur-based vulcanizing agent.

15 36. Process according to claim 35, wherein step (a) is carried out at a temperature of from 50°C to 150°C.

37. Process according to claim 35 or 36, wherein step (a) is carried out, for a time of from 5 min to 30 min.

20 38. Process according to claim 35, wherein said vulcanized rubber in a subdivided form is heated at a temperature of from 50°C to 150°C, before the addition of the silane coupling agent.

39. Process according to any one of claims 35 to 38, wherein step (b) is carried out at a temperature of from 100°C to 180°C.

40. Process according to any one of claims 35 to 39, wherein step (b) is carried out for 25 a time of from 2 min and 30 min.

41. Process according to any one of claims 35 to 40, wherein step (c) is carried out at a temperature of from 80°C to 120°C.

42. Process according to any one of claims 35 to 41, wherein step (c) is carried out for

- 36 -

a time of from 2 min to 30 min.

43. Process according to any one of claims 35 to 42, wherein the vulcanized rubber in a subdivided form is defined according to any one of claims 2 to 9.

44. Process according to any one of claims 35 to 43, wherein the diene elastomeric 5 polymer is defined according to any one of claims 10 to 12.

45. Process according to any one of claims 35 to 44, wherein the silane coupling agent is defined according to any one of claims 13 to 19.

46. Process according to any one of claims 35 to 45, wherein the sulfur-based vulcanizing agent is defined according to claim 20 or 21.